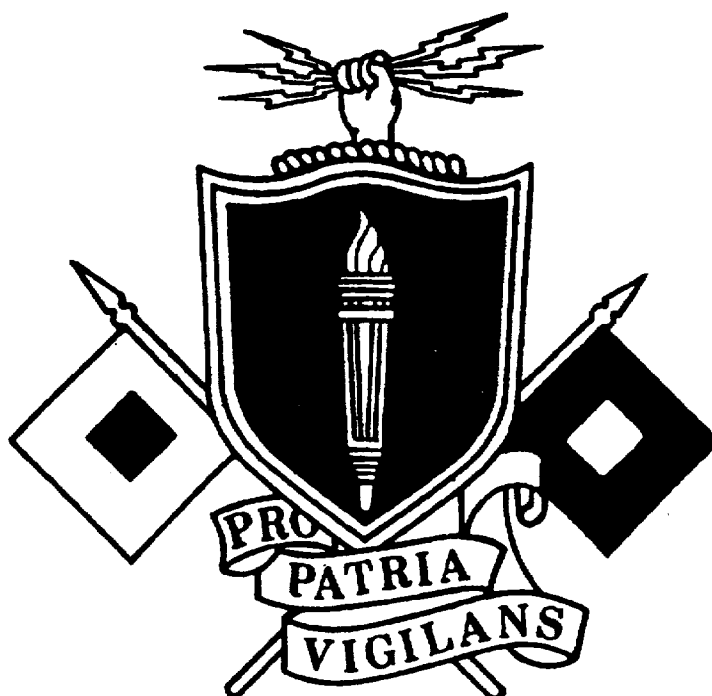


# LOCAL - BATTERY TELEPHONE PRINCIPLES



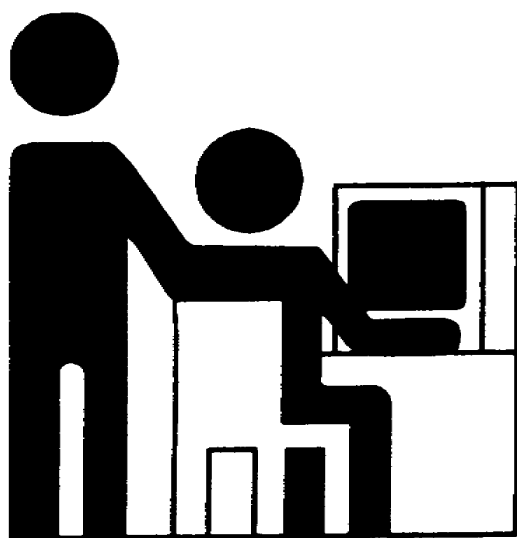
THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT  
ARMY CORRESPONDENCE COURSE PROGRAM

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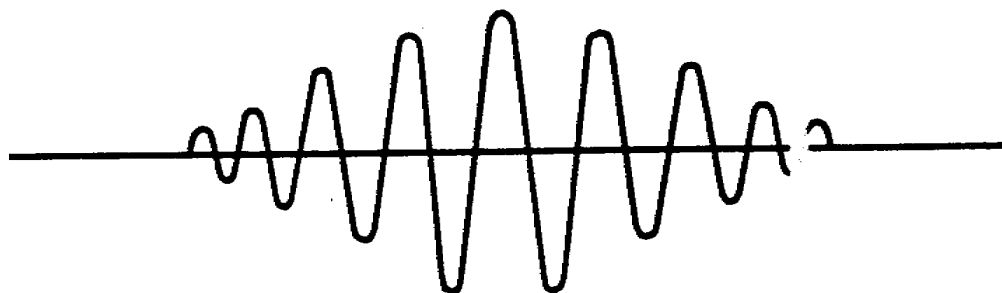
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to submit your questions, comments, and suggestions  
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## SUBCOURSE 410, LOCAL-BATTERY TELEPHONE PRINCIPLES

EDITION 8  
12 CREDIT HOURS  
REVISED: 1988

The study of telephony includes a study of sound and the principles used to convert sound waves into electrical impulses. These impulses are transmitted over wires or other media and reconverted into sound waves similar in form to the original waves. This feat was first accomplished by Alexander Graham Bell in 1876. Since that time, the telephone has become one of our primary means of communication.

The principles used by Bell when he invented the first telephone are still practical and are used extensively in military applications. In stable or semifixed situations, the more expensive and complex automatic dial telephone system is used. However, the simplicity of design, the sturdy construction, the ease of operation, the reduction of maintenance, and the low initial cost make the local-battery telephone system particularly suitable for tactical field operations.

The local-battery telephone system is desirable because of the rugged construction of its components and their ability to provide dependable communications over long distances and under adverse conditions.

The purpose of this subcourse is to teach you the fundamentals of telephony and prepare you for continued study on the more complex, more advanced elements of telephone communications.

This subcourse consists of five lessons and an examination, as follows:

Lesson 1. Sound and Telephony

Lesson 2. Local-battery Telephones

Lesson 3. Operation of Local-Battery Telephones

Lesson 4. Operation of Sound-Powered Telephones

Lesson 5. Operation of Amplifier Telephones

Examination

Credit Hours: 12

You are urged to finish this subcourse without delay; however, there is no specific limitation on the time you may spend on any lesson or the examination.

Texts and materials furnished:

Subcourse Booklet

Examination

TM 11-678, Fundamentals of Telephony, March 1953 (EXTRACTED)  
REVIEWED AND REPRINTED WITH MINOR REVISIONS JULY 1976.

TM 11-2059, Telephone TP-9 and Telephone Set TA-264/PT, October 1957 EXTRACTED

TM 11-5805-201-12, Organizational Maintenance Manual: Telephone Set TA-312/PT, July 1967 (EXTRACTED)

tm 11-5805-201-35, DS, GS and Depot Maintenance Manual: Telephone Set TA-312/PT, September 1967 (EXTRACTED)

TM 11-5805-243-13, Operator, Unit and Intermediate Direct Support Maintenance Manual, Telephone Set TA-1/PT, September 1987. (EXTRACTED)

**PLEASE NOTE**

**Proponency for this subcourse has changed  
from Signal (SS) to Missile & Munitions (MM).**

## LESSON 1

### SOUND AND TELEPHONY

CREDIT HOURS .....	2
TEXT ASSIGNMENT .....	TM 11-678, para 1-30
MATERIALS REQUIRED .....	None
LESSON OBJECTIVE .....	To familiarize you with the principles, characteristics, and transmission of sound and the construction and functions of the telephone transmitter and receiver.
SUGGESTIONS .....	Miniaturization and synthetics have changed the physical appearance of some of the telephones and telephone components illustrated in some figures of TM 11-678. However, the electrical circuits and the functions performed remain unchanged.

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### SPECIAL NOTE

Cycles per second (cps) is the unit of frequency. Texts often express the frequency only in cycles. However, the National Bureau of Standards has adopted the unit hertz (Hz) to replace cycles per second as the unit of frequency. Thus, 1 Hz - 1 cps.

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### LESSON EXERCISES

In each of the following exercises, select the ONE answer that BEST completes the statement or answers the question. Indicate your solution by circling the letter opposite the correct answer in the subcourse booklet.

1. The limitation to communication imposed by distance was practically eliminated by the invention of the telephone. The telephone system conquers distance by
  - a. transmitting the actual voice of the speaker to a receiver.
  - b. amplifying the sound waves and transmitting them over wires.

- c. transmitting electrical power and using it to produce sound similar to the speaker's voice.
  - d. concentrating the power of the sound waves and transmitting this power to a distant receiver.
2. Sound waves are transmitted through a medium. The property of a medium that determines its effectiveness as a medium is its
- a. mass.
  - b. density.
  - c. flexibility.
  - d. cross section.
3. Terms such as frequency, velocity, amplitude, period, pitch, quality, and wavelength are used to describe sound waves. The term that is used to express the relative compression of the air particles is called the
- a. velocity.
  - b. amplitude.
  - c. frequency.
  - d. wavelength.
4. The velocity of sound waves varies with the transmission medium. The medium through which sound travels at the fastest rate is
- a. air.
  - b. water.
  - c. solids.
  - d. a vacuum.
5. The flash of a cannon is seen 7 seconds before the report of the gun is heard. The distance from the observer to the gun is approximately
- a. 1 mile.
  - b. 1-1/2 miles.
  - c. 2-1/2 miles.
  - d. 4-1/2 miles..
6. The component of a sound wave that enables us to distinguish between speakers who pronounce the same word is the
- a. pitch.
  - b. velocity.
  - c. amplitude.
  - d. harmonics.
7. Sound waves cover a wide range of frequencies, but the human ear does not respond to all of these frequencies. The frequency of the audible range of sound for the average person is approximately
- a. 5 to 5,000 hertz.
  - b. 100 to 300 hertz.
  - c. 200 to 5,000 hertz.
  - d. 20 to 20,000 hertz.
8. A musical note is given quality by the harmonics, or overtones, which it contains. The frequency of the fourth harmonic of the note middle C is

- a. 64 hertz.
- b. 256 hertz.
- c. 1,024 hertz.
- d. 2,048 hertz.

9. Sounds are made up of fundamental frequencies and their harmonics. The fundamental frequencies contained in the normal speaking voice have a range of

- a. 50 to 200 hertz.
- b. 100 to 300 hertz.
- c. 100 to 1,200 hertz.
- d. 200 to 2,700 hertz.

10. The lungs furnish the power for human speech. The average power necessary for normal conversation is about

- a. 0.1 microwatt.
- b. 10 microwatts.
- c. 1,000 microwatts.
- d. 2,000 microwatts.

11. The ability of the human ear to respond to sound varies with the frequency of the sound wave. Tests with the audiometer have established that the frequency-of the sound easiest to hear is about

- a. 300 hertz.
- b. 1,000 hertz.
- c. 2,000 hertz.
- d. 4,000 hertz.

12. Bell's first telephones used sound-powered transmitters. In addition to the low input power, the most serious limiting factor to the transmission range of sound-powered transmitters is the

- a. lack of amplifying facilities.
- b. inflexibility of the diaphragms.
- c. inefficiency of permanent magnets.
- d. poor quality of the transmission media.

13. The condition of a carbon telephone transmitter can sometimes be determined by measuring its resistance. The resistance of a new transmitter is approximately

- a. 20 ohms.
- b. 35 ohms.
- c. 100 ohms.
- d. 300 ohms.

14. The development of the carbon transmitter greatly increased the transmitting device used by Bell. The nature of the current through the carbon transmitter during conversation can best be described as

- a. an alternating current.
- b. a steady direct current.
- c. a pulsating direct current.
- d. a complex alternating current.

15. Telephone transmitters generally pick up and transmit undesirable background noises. One transmitter, however, that is most effective in canceling these noises is the

- a. positional transmitter.
- b. differential transmitter.
- c. nonpositional transmitter.
- d. nondirectional transmitter.

16. Several types of telephone receivers are used to reconvert the electrical waves to sound waves. The type of receiver most commonly used for this purpose is the

- a. dynamic type.
- b. moving-coil type.
- c. moving-conductor type.
- d. magnetic-diaphragm type.

17. What is the purpose of the permanent magnet in a telephone receiver?

- a. To eliminate the need for poling
- b. To permit the use of smaller electromagnets
- c. To extend the transmission range of the telephone
- d. To prevent the diaphragm from vibrating at twice the received frequency

18. Many modern telephones have a varistor connected in the receiving circuit and installed in the handset. One of the purposes of this varistor is to

- a. eliminate sidetone in the receiver.
- b. make it unnecessary to pole the receiver.
- c. prolong the life of the permanent magnet.
- d. separate the transmitting circuit from the receiving circuit.

19. Telephone servicemen use diagrams when connecting equipment. The type of diagram that is best suited for checking a hookup after it is made is the

- a. block diagram.
- b. wiring diagram.
- c. pictorial diagram.
- d. schematic diagram.

20. One of the recommended procedures for learning to read and understand schematic diagrams is to memorize the

- a. symbols.
- b. circuit diagram.
- c. physical position of each component.
- d. resistance, voltage, and current of each part.

CHECK YOUR ANSWERS WITH LESSON SOLUTION SHEET # 1, PAGE 28.



## LESSON 2

### LOCAL-BATTERY TELEPHONES

CREDIT HOURS ..... 2

TEXT ASSIGNMENT ..... TM 11-678, para 41-60

MATERIALS REQUIRED ..... None

LESSON OBJECTIVE ..... To familiarize you with the design and the principle of operation of the components of the local-battery telephone set

SUGGESTIONS ..... None

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### LESSON EXERCISES

In each of the following exercises, select the ONE answer that BEST completes the statement or answers the question. Indicate your solution by circling the letter opposite the correct answer in the subcourse booklet.

1. When two local-battery telephone sets are connected together to form a telephone circuit, the signaling circuit consists of a

- a. battery, a ringer, and a generator.
- b. transmitter, a receiver, and a battery.
- c. generator, a ringer, and the connecting lines.
- d. receiver, a transmitter, a generator, a ringer, and the connecting lines.

2. Each telephone of a local-battery telephone system contains dry cell batteries. The purpose of the batteries is to enable the user to

- a. signal the operator.
- b. hear the other party.
- c. signal the other party.
- d. talk to the other party.

3. The characteristic of the dry cell battery which makes it unsuitable for delivering continuous current for long periods of time is the

- a. low EMF.
- b. polarizing action.
- c. high initial cost.
- d. limited current capacity.

4. A handset switch is mounted in the handset of the local-battery telephone. It is located at this convenient point so that the user may operate the switch while he is

- a. listening.
- b. signaling.
- c. monitoring.
- d. transmitting.

5. The transmitter and receiver of most telephone sets are mounted in the handset. This arrangement tends to increase the output of the transmitter because

- a. the position of the receiver gives the transmitter a booster effect.
- b. it assures the proper position of the transmitter while the user is speaking.
- c. the user will speak louder when the receiver blocks room noise from one ear.
- d. transmitters used in handsets are designed to be more efficient than those mounted in the telephone case.

6. The original models of the telephone did not have induction coils. The addition of the induction coil to the telephone circuit has resulted in improvements in

- a. range, efficiency, and performance.
- b. intelligibility, range, and efficiency.
- c. performance, intelligibility, and range.
- d. efficiency, performance, and intelligibility.

7. A varying current in one winding of a telephone induction coil will cause an ac voltage in the other winding. This transfer of electrical energy is a result of

- a. mutual induction.
- b. capacitive coupling.
- c. the common connection.
- d. the antisidetone principle.

8. Assume that a 90-volt, 20-hertz ac power source is connected to a transformer that has 25 turns in the primary winding. If the secondary winding has 10 turns, the value of the secondary voltage will be approximately

- a. 25 volts.
- b. 36 volts.
- c. 50 volts.
- d. 225 volts.

9. If two local-battery telephone sets are connected as shown in figure 50 (TM 11-678), speaking into the transmitter of telephone A will cause alternating current to flow in

- a. both receivers.
- b. the transmitter of telephone A.
- c. each transmitter and each receiver.
- d. the transmitter and receiver of telephone A and the receiver of telephone B.

10. Poling the telephone receiver is not required except in rare, special applications. To pole a receiver, the connections are arranged so that the

- a. direct current is barred from the receiver by the use of a capacitor.
- b. flux caused by the direct current aids the flux of the permanent magnet .
- c. flux caused by the direct current opposes the flux of the permanent magnet.
- d. direct current is barred from the receiver by the use of an induction coil.

11. The induction coil of a telephone must transfer power efficiently from the primary circuit to the secondary circuit. The type of induction coil that does this best is the

- a. solid, open-core type.
- b. solid, closed-core type.
- c. laminated, open-core type.
- d. laminated, closed-core type.

12. When the hand generator is used to signal the operator or another party, the telephone ringer is disconnected and the generator is connected to the line. This transfer is accomplished by the action of the

- a. hookswitch.
- b. line switch.
- c. handset switch.
- d. hand-generator switch.

13. The hand generator is a small ac generator operating on the principle of electromagnetic induction. The frequency of the signaling voltage delivered by the generator depends upon the

- a. speed of rotation.
- b. strength of the magnetic field.
- c. direction of the magnetic field.
- d. direction of motion of the conductor.

14. For the purpose of calculating telephone circuit values, the average frequency of voice currents is considered to be 1,000 hertz. What is the impedance of the two ringer coils to average voice currents?

- a. 1,000 ohms
- b. 1,300 ohms
- c. 18,750 ohms
- d. 26,000 ohms

15. The armature of the hand generator has a relatively low impedance. What prevents the shunting of voice currents through the armature during conversation?

- a. The open handset switch
- b. A high-impedance capacitor
- c. The open hand-generator switch
- d. The high impedance of the ringer coils

16. The amount of energy that a capacitor can store is affected by several factors. However, one factor that does NOT affect the capacity of a capacitor is the

- a. frequency.
- b. impressed voltage.
- c. size of the plates.
- d. distance separating the plates.

17. Assume an electrical circuit containing a 60-hertz generator, a non-inductive resistance, a capacitor, a receiver, and one winding of an induction coil. (Draw the circuit.) If the frequency of the generator is changed to 20 hertz, which component will have an increased opposition to the flow of current?

- a. The resistor
- b. The receiver
- c. The capacitor
- d. The induction coil

18. A 0.5-microfarad capacitor is usually connected in the receiver circuit of a local-battery telephone. This capacitor increases the signaling range by offering a

- a. low impedance to 20-hertz currents.
- b. high impedance to 20-hertz currents.
- c. low impedance to voice-frequency currents.
- d. high impedance to voice-frequency currents.

19. Sidetone in a telephone is the speaker's own voice heard in his receiver. In the most desirable design of telephone sets, the amplitude of sidetone should be

- a. zero.
  - b. loud.
  - c. faint.
  - d. normal.
20. Sidetone is controlled by the antisidetone circuit-in a telephone. This circuit controls the sidetone by
- a. isolating the transmitter circuit during transmission.
  - b. opening the circuit to the receiver during transmission.
  - c. using separate transformers for the primary and secondary circuits.
  - d. balancing the components that are connected in parallel with the receiver.

CHECK YOUR ANSWERS WITH LESSON SOLUTION SHEET # 2, PAGE 29.

## LESSON 3

### OPERATION OF LOCAL-BATTERY TELEPHONES

CREDIT HOURS ..... 2

TEXT ASSIGNMENT ..... TM 11-5805-201-12, para 1-4 to 4-4;  
TM 11-5805-201-35, para 2-1 to 3-5

MATERIALS REQUIRED ..... None

LESSON OBJECTIVE ..... To familiarize you with the installation, operation, and  
maintenance of local-battery telephones

SUGGESTIONS ..... None

#### LESSON EXERCISES

In each of the following exercises, select the ONE answer that BEST completes the statement or answers the question. Indicate your solution by circling the letter opposite the correct answer in the subcourse booklet.

1. A point-to-point circuit is one in which the two parties are connected directly, without benefit of operator or switchboard. An all-weather point-to-point circuit using Telephone Sets TA-312/PT and Wire WD-1/TT is limited to a range of approximately

- a. 22.5 kilometers (14 mi).
- b. 35.4 kilometers (22 mi).
- c. 40.3 kilometers (25 mi).
- d. 45.7 kilometers (29 mi).

2. Two requirements must be met before installing or replacing batteries in the TA-312/PT. One requirement consists of

- a. operating the hookswitch.
- b. removing Handset H-60/PT.
- c. disconnecting the line leads.
- d. setting the selector switch to the LB position.

3. The purpose of the INT-EXT switch on Telephone Set TA-312/PT is to
  - a. select internal or external battery supply.
  - b. select common-battery or local-battery operation.
  - c. signal the operator during local-battery operation.
  - d. connect the telephone handset or the handset-headset.
4. The type of telephone system that requires the use of the hand generator in Telephone Set TA-312/PT for signaling the operator is the
  - a. local-battery system.
  - b. common-battery system.
  - c. point-to-point system.
  - d. common-battery-signaling system.
5. The handset of Telephone Set TA-312/PT contains a press-to-talk switch. This switch must be operated during transmission when the telephone is used for
  - a. local-battery or common-battery operation.
  - b. local-battery or common-battery-signaling operation.
  - c. common-battery or common-battery-signaling operation.
  - d. local-battery, common-battery, or common-battery-signaling operation.
6. "Ring-off" is an operational procedure that is used to signify the end of a call. It is used when a field telephone is connected to a
  - a. local-battery switchboard.
  - b. common-battery switchboard.
  - c. common-battery-signaling switchboard.
  - d. remote-controlled radiotelephone circuit.
7. If the common-battery operation of a TA-312/PT is unsatisfactory because of the length of the line loop, the recommended method of improving transmission is to operate the telephone as
  - a. an amplifier telephone.
  - b. a local-battery telephone.

- c. a sound-powered telephone.
- d. a common-battery-signaling telephone.

8. Telephone Set TA-312/PT may be operated in emergencies without batteries. This type of operation utilizes the receiver as a sound-powered transmitter and will provide communication for a maximum distance of approximately

- a. 6.41 km (4 mi).
- b. 12.88 km (8 mi).
- c. 19.32 km (12 mi).
- d. 25.56 km (16 mi).

9. Repair and maintenance of Telephone Set TA-312/PT is a function of direct support and general support maintenance. However, the organizational maintenance man is permitted to

- a. apply moisture and fungus-proofing.
- b. repair any breaks in internal wiring.
- c. replace or adjust the handset retaining springs.
- d. change or replace the transmitter or receiver.

## SPECIAL NOTE

To perform maintenance and repair on Telephone Set TA-312/PT, or any communication equipment, requires a thorough knowledge of the equipment and a complete understanding and interpretation of schematic and wiring diagrams of the equipment. Figure 5-1 of TM 11-5805-201-35 will be very helpful in solving the remaining exercises of the lesson.

10. Switches in figure 5-1 are labeled S. Switch S4 can be identified as the

- a. hookswitch.
- b. handset switch
- c. INT-EXT switch.
- d. selector Switch.

11. When the TA-312/PT is connected for common-battery use, a dc path through the telephone will signal the switchboard. If the switchboard receives a signal when hookswitch S2 is open, the probable trouble is

- a. a short through the buzzer.
- b. a short through capacitor P1.
- c. an open at the terminal board.
- d. an open at the generator switch.



12. When the hand generator is used to signal on an LB line, any signal current through the telephone will weaken the outgoing signal. The set of open hookswitch contacts that excludes all signal current from the local set is

- a. 1 and 2.
- b. 3 and 4.
- c. 5 and 6.
- d. 7 and 8.

13. Assume the handset-headset is connected to Telephone Set TA-312/PT in a common-battery system. In normal operation, the contacts that close the signal circuit to the operator are

- a. 1 and 2 of switch S2.
- b. 3 and 4 of switch S2.
- c. 3 and 4 of switch S3.
- d. 8 and 9 of switch S1.

14. The internal resistance of the self-contained transmission battery is relatively low. Voice-frequency currents are prevented from taking this low-resistance path by

- a. coil H.
- b. inductor E.
- c. resistance B.
- d. holding coil J.

15. When Telephone Set TA-312/PT is used on common-battery loops, the length of the line loop will affect the voltage that is supplied to the telephone set. The variations in the line voltage are somewhat stabilized by the action of

- a. inductor A.
- b. resistor C.
- c. capacitor K.
- d. varistor CR1.

16. The antisidetone circuit of Telephone Set TA-312/PT is designed so that voice currents in the receiver will be minimum while transmitting and maximum while receiving. This is possible because

- a. varistors CR1 and CR2 reduce voice currents during transmission.
- b. the press-to-talk switch reduces voice currents through the receiver when transmitting.
- c. voice currents in coils A and H are opposing while transmitting, and aiding while receiving.
- d. voice currents entering the telephone are stronger than the voice currents leaving the telephone.

17. A troubleshooting chart lists the trouble symptoms and probable corrections. If a telephone transmits properly but does not receive, a possible trouble is

- a. an open resistor (L).
- b. a shorted varistor (CR3).
- c. a defective selector switch.
- d. a defective press-to-talk switch.

18. For LB or CBS operation, the transmitter circuit of the TA-312/PT passes through contacts of three of the four switches in the set. The switch that does NOT provide part of the transmitter path is

- a. S1.
- b. S2.
- c. S3.
- d. S4.

19. Many troubles are identified by measuring the resistance of components. An ohmmeter reading between terminals 7 and 10 of Impedance Matching Network CU-350/PT will check the condition of

- a. coil E.
- b. winding A.
- c. winding C.
- d. resistor B.

20. The internal resistance of the generator (G-42A/PT) can be measured by connecting an ohmmeter to line terminals 1 and 2. What preliminary action must you take to make this test?

- a. Disconnect varistor CR3.
- b. Set selector switch at LB.
- c. Operate press-to-talk switch.
- d. Turn handcrank to close contacts.

CHECK YOUR ANSWERS WITH LESSON SOLUTION SHEET # 3, PAGE 30.

## LESSON 4

### OPERATION OF SOUND-POWERED TELEPHONES

CREDIT HOURS ..... 2

TEXT ASSIGNMENT ..... TM 11-678, para 169-178

TM 11-5805-243-13,  
para 1-8 through 2-11  
para 5-1 through 5-26

MATERIALS REQUIRED ..... NONE

LESSON OBJECTIVE..... To familiarize you with installation operation, and  
maintenance of sound-powered telephone sets

SUGGESTIONS..... NONE

### LESSON EXERCISES

In each of the following exercises, select the ONE answer that BEST completes the statement or answers the question. Indicate your solution by circling the letter opposite the correct answer in the subcourse booklet.

1. The transmitter of the sound-powered telephone differs greatly from that of the conventional or battery-powered telephone. The basic principle that permits this transmitter to operate is that of
  - a. electrochemical reaction.
  - b. electromagnetic induction..
  - c. electronic-amplification of sound waves.
  - d. a varying resistance in an established electrical circuit.
2. The armature in the transmitter of a sound-powered telephone is actuated by the diaphragm. When sound waves strike the diaphragm, the waveshape of the generated voltage is a
  - a. sine wave.
  - b. complex wave.
  - c. straight line.
  - d. double sine wave.

3. Despite the fact that sound-powered transmitters and receivers are constructed identically, their armature motivation is different. The armature of the receiver is moved by

- a. sound waves.
- b. the diaphragm.
- c. the induced voltage.
- d. magnetic attraction and repulsion.

4. At the end of each complete cycle of current, the armature of the sound-powered receiver returns to its in-between position of rest. The armature is returned to this position by a force applied by the

- a. electromagnet.
- b. permanent magnet.
- c. mechanical coupling.
- d. generated sound waves.

5. The signaling circuit of the sound-powered telephone (fig. 206, TM 11-678) is connected across the transmission line during conversation, but the transmission loss through this circuit is small because of the high impedance of

- a. the ringer.
- b. capacitor C2.
- c. the generator.
- d. the neon lamp.

6. Ringing current for the sound-powered telephone to signal the operator or distant party is provided by a local generator (fig. 206, TM 11-678). During signaling, ringing current is prevented from entering the local ringer by

- a. switch S1.
- b. switch S2.
- c. capacitor C1.
- d. capacitor C2.

7. When compared with the battery-operated telephone system, a disadvantage of the sound-powered telephone system is

- a. less rugged components.
- b. poorer frequency response.
- c. shorter transmission range.
- d. heavier and bulkier telephone sets.

8. Telephone Set TA-I/PT is a sound-powered telephone designed for field use. It has an effective signaling and transmission range over Wire WD-1/TT of approximately

- a. 4 miles (6.44 km).
- b. 14 miles (22.54 km).
- c. 22 miles (35.42 km).
- d. 29 miles (46.69 km).

9. Telephone Set TA-1/PT has an audible signal and a visual signal for incoming calls. When the visual indicator has been actuated, it can be reset by

- a. pressing the generator lever.
- b. depressing the press-to-talk switch.
- c. short-circuiting the line binding posts.
- d. rotating the buzzer control knob to OFF.

10. The generator lever on Telephone Set TA-1/PT is operated by a pumping action to deliver a ringing signal to the distant party. This lever should be released during transmission to

- a. disconnect the buzzer from the line.
- b. disconnect the receiver from the line.
- c. disconnect the generator from the line.
- d. reconnect the transmitter into the line.

11. One precaution that should be observed while the generator lever is being used to signal the operator is that the

- a. visual indicator should be unoperated.
- b. press-to-talk switch should be released
- c. buzzer volume control knob should be at OFF.
- d. buzzer volume control knob should be set to LOUD.

12. When the receiver of Telephone Set TA-1/PT is out of order and the transmitter is used for listening, one exception to the normal operating procedure must be observed. This exception in the use of the press-to-talk switch requires the switch to be

- a. operated while receiving.
- b. unoperated while receiving.
- c. operated while transmitting.
- d. unoperated while transmitting.

13. Because of the lack of tools and materials, repairs to Telephone Set TA-1/PT by the operator or organizational maintenance man are limited to minor repairs. However, one maintenance function for which the organizational maintenance man is responsible is the

- a. repair of the visual indicator.
- b. repair to the press-to-talk switch.
- c. replacement of the buzzer volume control.
- d. replacement of the moisture-preventing diaphragms.

14. When the buzzer volume control knob on the TA-1/PT is turned to OFF, no sound is produced by incoming signals. The production of sound is prevented by

- a. opening the circuit to the buzzer.
- b. clamping the armature of the buzzer.
- c. shunting the circuit around the buzzer.
- d. increasing the separation between the armature and the diaphragm.

15. The incoming voice signals to the TA-1/PT pass only through the receiver unit (fig 1, para 5-3 TM 5805-243-13) current are prevented from passing thorough the transmitter element by

- a. generator switch S2.
- b. limiting resistor R1.
- c. press-to-talk switch S1.
- d. high impedance in the buzzer winding.

16. Telephone Set TA-1/PT consists of four local circuits which can be traced from L1 to L2 in figure 1 of TM 11-5805-243-35. Tracing these circuits will disclose that capacitor C1 is common to the

- a. voice transmission circuit and the voice reception circuit.
- b. voice reception circuit and the outgoing signaling circuit.
- c. outgoing signaling circuit and the incoming signaling circuit.
- d. incoming signaling circuit and the voice transmission circuit.

17. Assume that troubleshooting procedures show that the buzzer operates satisfactorily on incoming signals, but the visual indicator does not. The probable trouble is a defective

- a. buzzer coil.
- b. buzzer diaphragm.
- c. visual indicator coil.
- d. visual indicator mechanism.

18. What will be the symptom if resistor R1 in Telephone Set TA-1/PT becomes open?
- a. The buzzer will not sound.
  - b. The user will not hear sidetone.
  - c. The telephone will not transmit.
  - d. Incoming ringing signals will be heard in the receiver.
19. Which of the four internal circuits of the TA-1/PT has the greatest dc resistance?
- a. The voice reception circuit
  - b. The voice transmission circuit
  - c. The outgoing signaling circuit
  - d. The incoming signaling circuit
20. Assume that a multimeter (ohmmeter) is connected between terminal 2 of TB2 and terminal B of TB1 (fig. 1, TM 11-5805-243-35). When the press-to-talk switch is operated, the multimeter will read the resistance of the
- a. receiver.
  - b. transmitter.
  - c. resistor R1.
  - d. indicator coil.

CHECK YOUR ANSWERS WITH LESSON SOLUTION SHEET 0 4, PAGE 31.

## LESSON 5

### OPERATION OF AMPLIFIER TELEPHONES

CREDIT HOURS ..... 2

TEXT ASSIGNMENT ..... TM 11-2059, para 3-46

MATERIALS REQUIRED ..... None

LESSON OBJECTIVE..... To familiarize you with the installation, operation, and maintenance of amplifier telephones

SUGGESTIONS..... Some changes have been made in the forms used and records kept of organizational maintenance since TM 11-2059 was printed. However, the actions performed and the checks made are essentially as shown in the TM.

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### LESSON EXERCISES

In each of the following exercises, select the ONE answer that BEST completes the statement or answers the question. Indicate your solution by circling the letter opposite the correct answer in the subcourse booklet.

1. Telephones TP-9 and TA-264/PT have similar operating characteristics and can be used interchangeably. Compared with ordinary local-battery sets, these telephones have the advantage of being

- a. lighter in weight.
- b. simpler to operate.
- c. more ruggedly constructed.
- d. capable of transmitting over longer lines.

2. The attenuation of voice frequencies over field wire is approximately 1 db per kilometer in wet weather. Therefore, the maximum range of a point-to-point circuit which uses Telephone Sets TA-264/PT over field wire is approximately

- a. 15 km.
- b. 23 km.
- c. 55 m.
- d. 65 km.



3. Assume that a repairman installs new batteries in two Telephone Sets TA-264/PT that are used in a point-to-point circuit. Under normal conditions of intermittent operation, he should plan to replace these batteries in about

- a. 2 weeks.
- b. 3 to 4 weeks.
- c. 6 to 8 weeks.
- d. 8 to 10 weeks.

4. Improvements in equipment are reflected in new models or new nomenclature. For example, the major difference between Telephone Set TA-264/PT and Telephone TP-9 is in the

- a. case.
- b. vacuum tubes.
- c. battery supply.
- d. hand ringing generator.

5. Special precautions must be taken to conserve the batteries in Telephone Set TA-264/PT when the set is not being used. This conservation is accomplished by

- a. latching the cradle switch down.
- b. removing the batteries from the set.
- c. turning the gain control knob to minimum.
- d. disconnecting the batteries at the terminal board.

6. Telephone Set TA-264/PT can be operated as an ordinary field telephone or as an amplifier telephone. When operation without amplification is desired, the amplifier section is made inoperative by

- a. operating the handset switch.
- b. locking the cradle switch lever down.
- c. adjusting the GAIN control switch to OFF.
- d. setting the SIG-BELL switch to the SIG position.

7. Telephone Set TA-264/PT is essentially a local-battery telephone. Its use differs slightly from that of the local-battery set because the type of operation with this set is

- a. one-way only.
- b. point-to-point only.
- c. two-way simultaneously.
- d. two-way, but not simultaneously.

8. When using Telephone Set TA-264/PT, prearranged signals are used as part of the normal operating procedures to interrupt the speaker. A telephone user desiring to interrupt the speaker must attract his attention by

- a. jiggling the hookswitch.
- b. transmitting the word "break."
- c. sending ringing current over the line.
- d. requesting assistance from the operator.

9. What special action is recommended to insure a reliable electrical supply to Telephone Set TA-264/PT when it is operated in subzero climates?

- a. Provide additional insulation for the batteries.
- b. Warm the batteries by body heat until ready to use.
- c. Replace the batteries with low-temperature batteries.
- d. Substitute an external power source for the battery supply.

10. Because of the complexity of Telephone Set TA-264/PT and the limitation of tool and spare parts, maintenance that can be performed by the operator is minor. However, he may replace such items as

- a. batteries.
- b. binding posts.
- c. handset cords.
- d. generator handles.

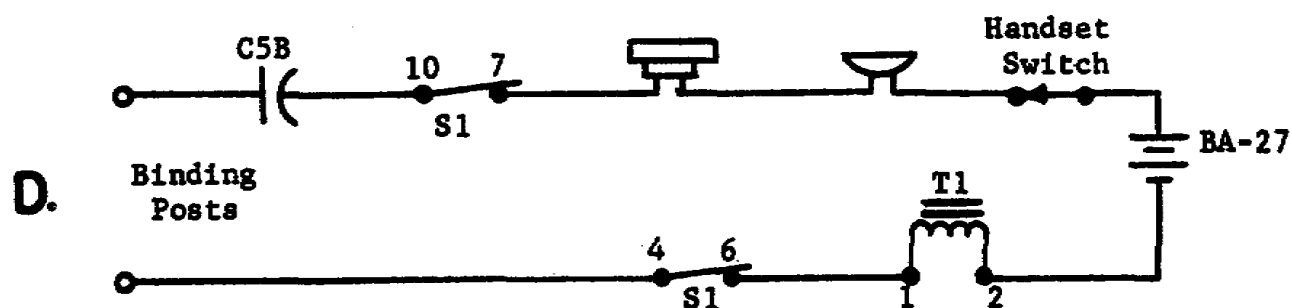
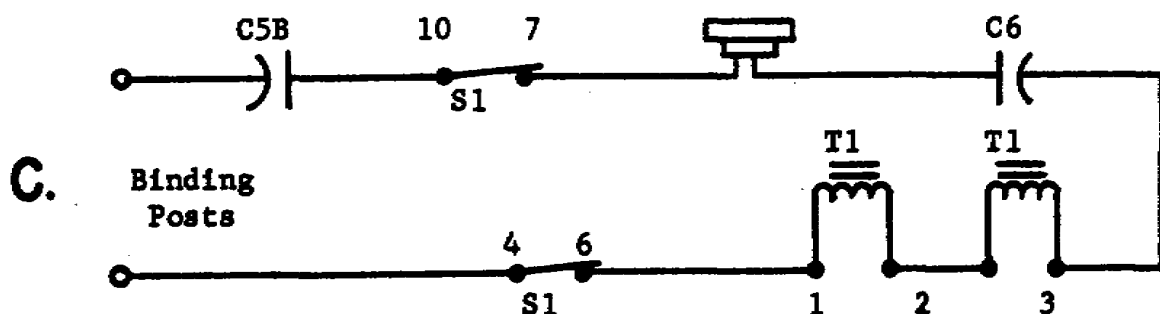
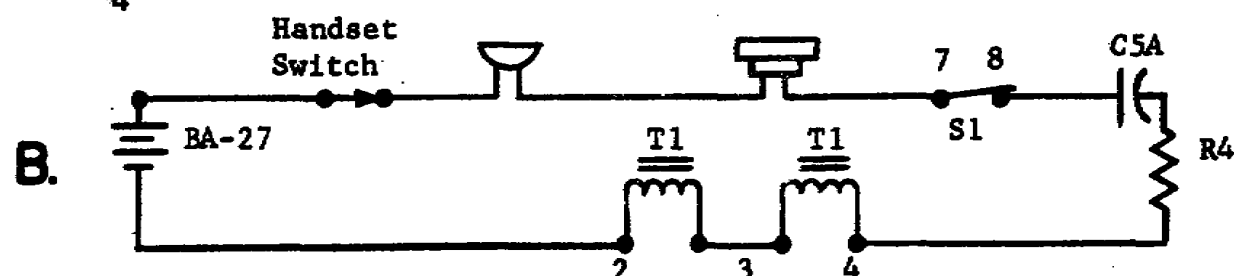
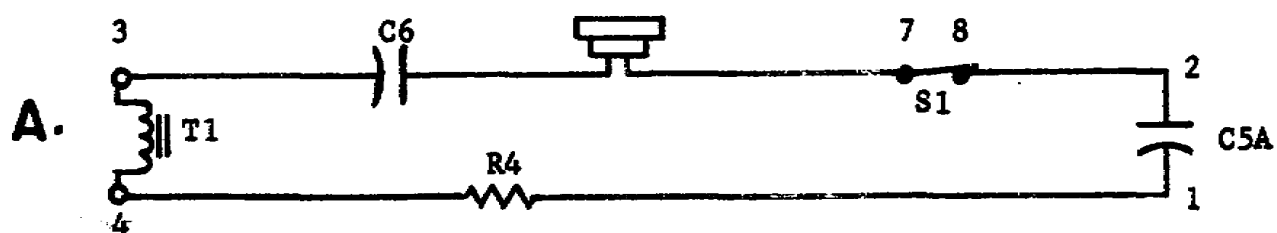
11. To compensate for the higher attenuation of certain frequencies of a voice signal, the receiving amplifier of Telephone Set TA-264/PT is designed to give greater amplification to these frequencies. The greatest amplification is to frequencies in the range of approximately

- a. 1,000 hertz.
- b. 1,400 hertz.
- c. 2,200 hertz.
- d. 4,000 hertz.

12. When the amplifying telephone is to be used as a local-battery set without amplification, the filament circuit to the vacuum tubes is open (fig. 21). This circuit is opened at the contacts of

- a. switch S2.
- b. wafer X of switch S1.
- c. wafer Y of switch S1.
- d. wafer Z of switch S1.

13. When Telephone Set TA-264/PT is used as a local-battery telephone, sidetone is heard in the receiver. The path for this sidetone current is as follows:



14. Vacuum tube V2 is used to amplify received, or incoming, signals in the TA-264/PT. This tube does not amplify the transmitted, or outgoing, signals because
- a. the filament circuit is open.
  - b. contacts 3 and 4 of relay K1 shunt network L1.
  - c. the outgoing signal is canceled by the sidetone.
  - d. bypass capacitor C7 diverts the outgoing signals.
15. The incoming signals to Telephone Set TA-264/PT induce a voltage in the windings of transformer T3 (fig. 11). The component in this circuit which determines the gain of the signal is
- a. R1.
  - b. R3.
  - c. R8.
  - d. R12.
16. Vacuum tube V3 provides the second stage of amplification for the received signal in the TA-264/PT. Its output is fed to the telephone receiver through
- a. choke L1.
  - b. capacitor C4.
  - c. transformer T4.
  - d. potentiometer R12.
17. Outgoing currents for signaling the distant station are generated when the hand generator is turned. The circuit for this current is closed at
- a. contacts 1 and 2 of switch S2.
  - b. contacts 2 and 3 of switch S2.
  - c. contacts 1 and 3 of the hand generator.
  - d. contacts 2 and 3 of the hand generator.
18. Line faults and equipment faults are the major troubles encountered in telephone systems. A faulty line is indicated when the user of a TA-264/PT receives
- a. normal ringing but no speech signals.
  - b. no speech transmission and no ringing signal.
  - c. normal voice transmission but no ringing signal.
  - d. intermittent speech signals and normal ringing signals.
19. If Telephone Set TA-264/PT receives satisfactorily with amplification but does not transmit, a probable trouble is a defective

- a. transformer T4.
- b. vacuum tube V1.
- c. vacuum tube V2.
- d. bypass capacitor C7.

20. Point-to-point voltage charts help to localize troubles in Telephone Set TA-264/PT. With the handset switch released, the voltage between pin 7 of tube V1 and terminal 6 of transformer T1 in the TA-264/PT should be approximately

- a. 1.3 volts.
- b. 1.5 volts.
- c. 2.2 volts.
- d. 5.0 volts.

CHECK YOUR ANSWERS WITH LESSON SOLUTION SHEET # 5, PAGE 32.

HOLD ALL TEXTS AND MATERIALS FOR USE WITH EXAMINATION

## SOLUTIONS

SUBCOURSE 410..... Local-Battery Telephone Principles

LESSON 1 ..... Sound and Telephony

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All references are to TM 11-678.

1. c--para 1b
  2. b--para 3b
  3. b--para 5b, fig. 4
  4. c--para 6a
  5. b--para 6a, fig. 4
  6. d--para 7b
  7. d--para 8a
  8. c--para 7a, 8a
  9. b--para 11a
  10. b--para 12
  11. c--para 13b
  12. a--para 19b (5)
  13. b--para 20b (1)
  14. c--para 20b (2)
  15. b--para 22b, c
  16. d--para 23b (1)
  17. d--para 24a (2)
  18. c--para 25b (3)
  19. b--para 26b (2)
  20. a--para 27b
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## SOLUTIONS

SUBCOURSE 410 ..... Local-Battery Telephone Principles

LESSON 2 ..... Local-Battery Telephones

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All references are to TM 11-678.

1. c--para 42a (2), fig. 40
  2. d--para 43
  3. b--para 43
  4. d--para 44b
  5. b--para 45a
  6. a--para 46
  7. a--para 47a
  8. b--para 47b (4)
  9. a--para 48a (2), (3)
  10. b--para 48c
  11. d--para 49a
  12. d--para 50d
  13. a--para 52b
  14. c--para 53c
  15. c--para 54
  16. a--para 55b (1)
  17. c--para 55b (2)
  18. b--para 57b, c
  19. c--para 59
  20. d--para 60b
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## SOLUTIONS

SUBCOURSE 410 ..... Local-Battery Telephone Principles

LESSON 3 ..... Operation of Local-Battery Telephones

All references are to TM 11-5805-201-12, unless otherwise indicated.

1. a--para 1-5d
2. b--para 2-3f (1)
3. d--para 3-1
4. a--para 3-1
5. b--para 3-2a (3), c (5)
6. a--para 3-2c (6), d (5)
7. d--para 3-4e
8. a--para 3-4f
9. c--para 4-4
10. b--TM 11-5805-201-35, fig. 5-1
11. b--TM 11-5805-201-35, para 2-2a, fig. 5-1
12. b--TM 11-5805-201-35, para 2-2b, fig. 5-1
13. c--TM 11-5805-201-35, para 2-2e, fig. 5-1
14. b--TM 11-5805-201-35, para 2-3a (1), fig. 5-1
15. d--TM 11-5805-201-35, para 2-3b (1), fig. 5-1
16. c--TM 11-5805-201-35, para 2-3d, fig. 5-1
17. b--TM 11-5805-201-35, para 3-4, item 7; fig. 5-1
18. c--TM 11-5805-201-35, para 3-4, item 5; fig. 5-1
19. d--TM 11-5805-201-35, para 3-5, fig. 5-1
20. d--TM 11-5805-201-35, para 3-5 (Note b), fig. 5-1



## SOLUTIONS

SUBCOURSE 410..... Local-Battery Telephone Principles

LESSON 4..... Operation of Sound-Powered Telephones

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All references are to TM 11-678, unless otherwise indicated.

1. b--para 170b, fig. 201
  2. b--para 171b
  3. d--para 172b (l)
  4. c--para 173c
  5. a--para 175a (2)
  6. b--para 175a (3)
  7. c--para 176b
  8. a--TM 11-5805-243-13, para 1-10
  9. b--TM 11-5805-243-13, para 2-2
  10. c--TM 11-5805-243-13, 5-4, fig 5-3
  11. b--TM 11-5805-243-13, para fig 5-3
  12. a--TM 11-5805-243-13, para 2-8
  13. d--TM 11-5805-243-13, para 5-1(5)
  14. b--TM 11-5805-243-13, para 5-5
  15. c--TM 11-5805-243-13, para 5-7 fig 5-3
  16. a--TM 11-5805-243-13, para 5-6, 5-7, fig 5-3
  17. d--TM 11-5805-243-13, para 5-11, 5-26
  18. b--TM 11-5805-243-13, para 5-11
  19. c--TM 11-5805-243-13, para 5-12, fig 5-3
  20. c--TM 11-5805-243-13, fig 5-3
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## SOLUTIONS

SUBCOURSE 410..... Local-Battery Telephone Principles

LESSON 5..... Operation of Amplifier Telephones

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All references are to TM 11-2059.

1. d--para 3
  2. d--para 4
  3. b--para 7a (3) Note
  4. d--para 8
  5. a--para 12a (8)
  6. b--para 14, 17b
  7. d--para 15a
  8. c--para 19
  9. c--para 21a
  10. a--para 27
  11. c--para 35b, fig. 7
  12. c--para 35d, fig. 21
  13. a--para 38b, fig. 9
  14. b--para 39b, c; 40a; fig. 10, 11
  15. d--para 40b, fig. 11
  16. c--para 40d, fig. 11
  17. c--para 41b, fig. 12
  18. b--para 43a
  19. b--para 39b, 44
  20. d--para 45
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